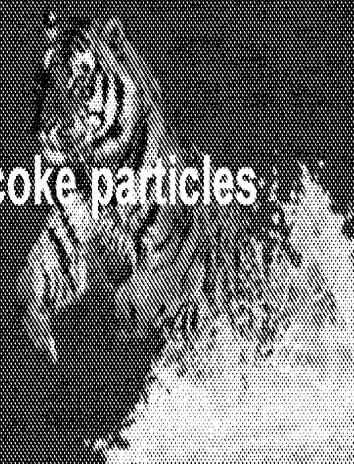


FLEXICOKING Process Description

Gasifier

- 900 - 950 °C, 7 meter high fluidized bed, 16 meter diameter
- Coke gasification / combustion
 - $C + \frac{1}{2}O_2 \rightarrow CO$ exo
 - $C + H_2O \rightarrow CO + H_2$ endo
 - $C + CO_2 \rightarrow 2CO$ endo
- Gasifies approx. 85-90% of reactor coke production
 - Low Joule Gas contains 50% nitrogen and H_2 , CO , CO_2 , H_2S and NH_3
 - Temperature control with steam
- Coke circulation for heat transfer and prevents too small coke particles











Hot spots



175.0°C

175.0

170.0

165.0

160.0

155.0

150.0

145.0

140.0

135.0

130.0

125.0

120.0

115.0

110.0

105.0

100.0

95.0

90.0

85.0

80.0

75.0

70.0

65.0

60.0

55.0

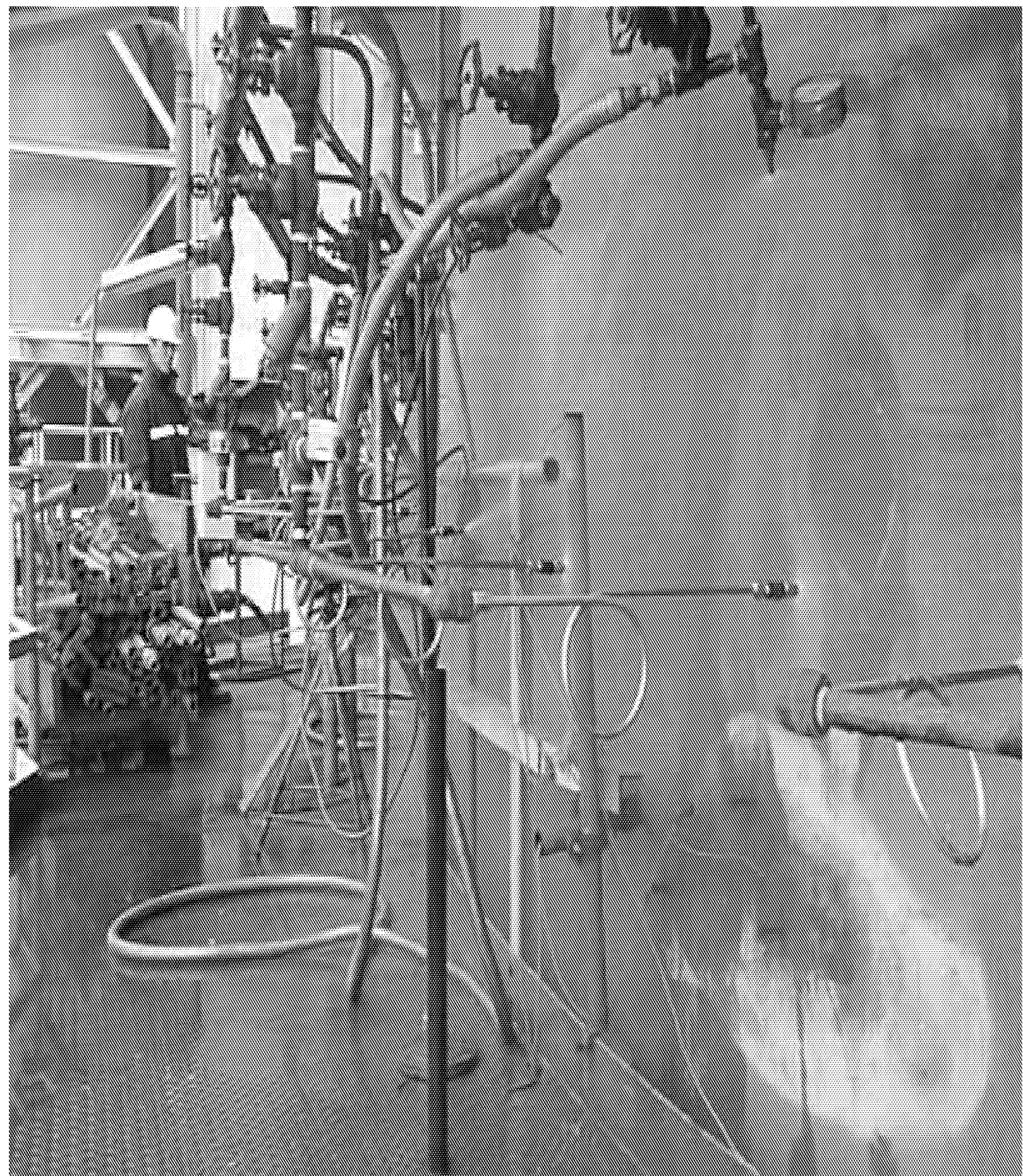
50.0

Spot 3
133.2

Spot 2
170.6

Spot 1
168.0





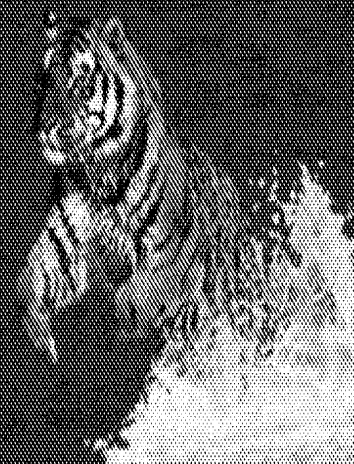
FLEXICOKING Process Description

Coke Transfer lines

Guess how many ?

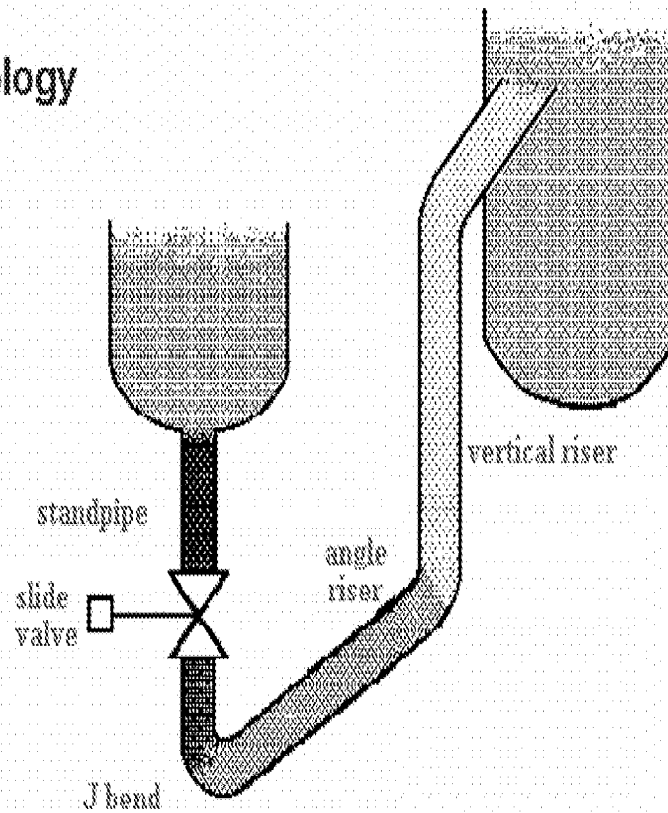
- Rx-Hx 3x
- Hx-Gx 2x
- Hx-Qx 1x

How can you transfer coke against the pressure ?



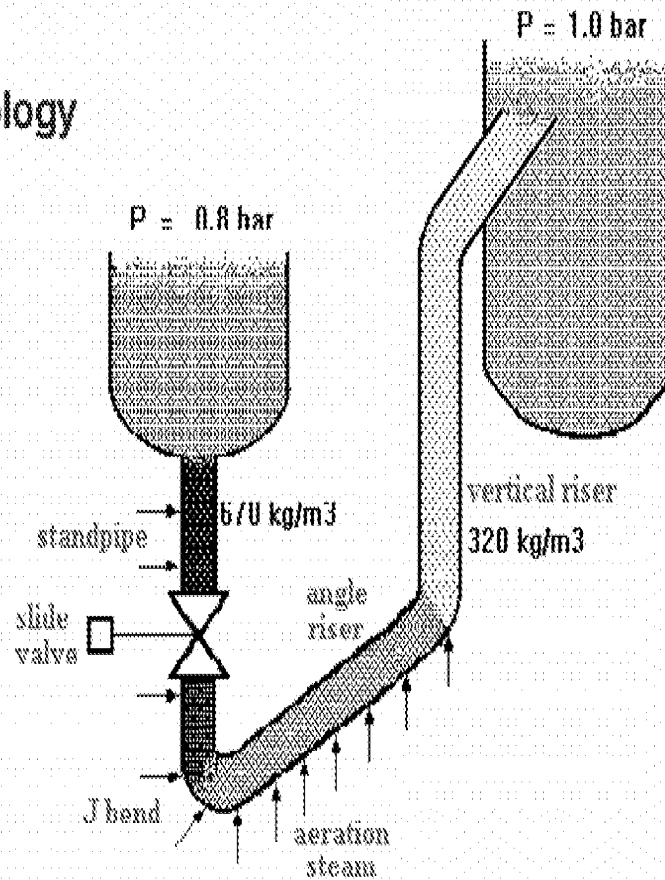
Transport in Fluidized State

- Transfer line terminology



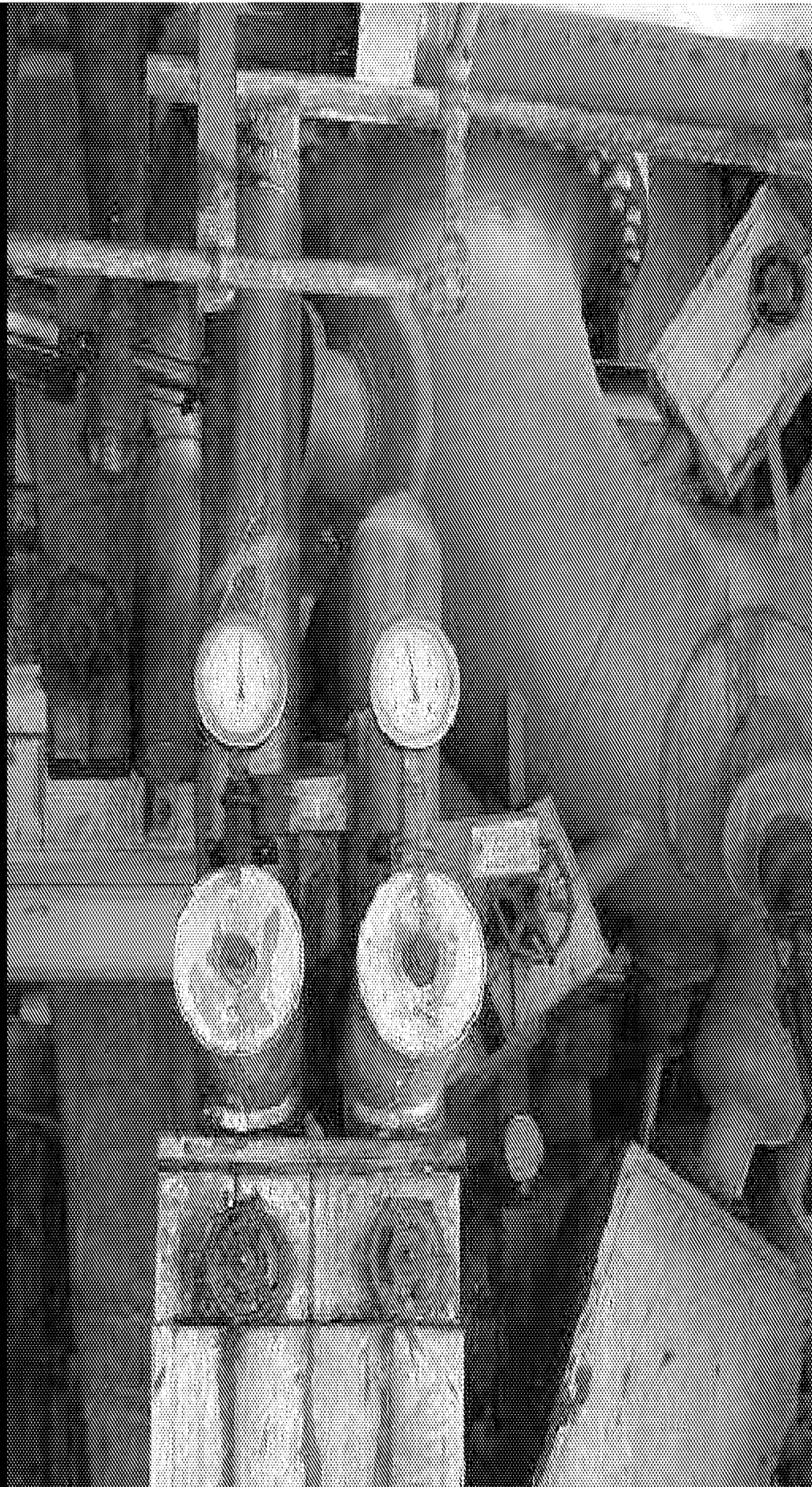
Transport in Fluidized State

- **Transfer line terminology**



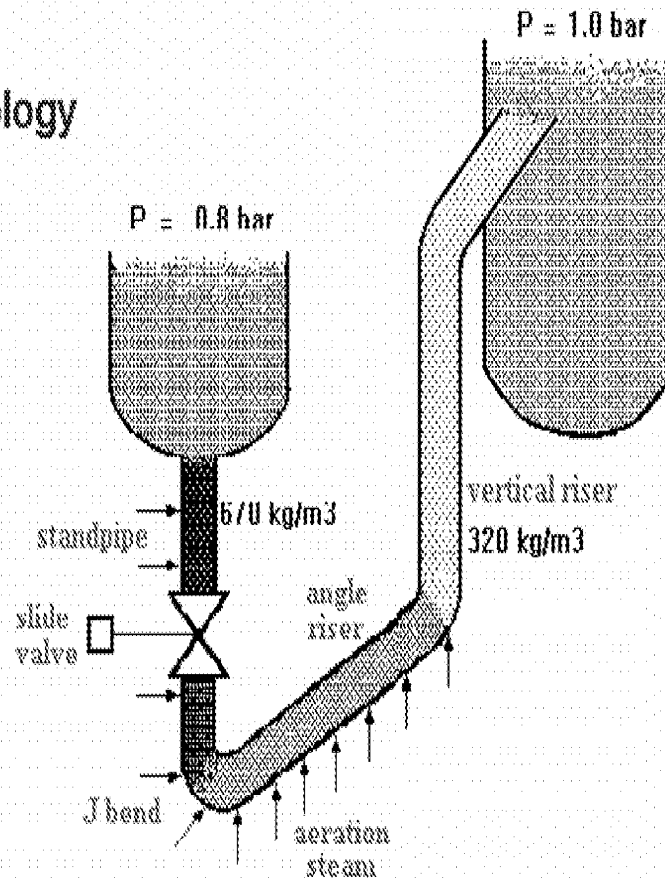
- **Pressure balance**

- ◆ static pressure build-up in standpipe provides driving force for coke transport
- ◆ flow control by slide valve or riser aerations



Transport in Fluidized State

- Transfer line terminology



- Pressure balance

- ❖ static pressure build-up in standpipe provides driving force for coke transport
- ❖ flow control by slide valve or riser aerations

- Limitations to aeration

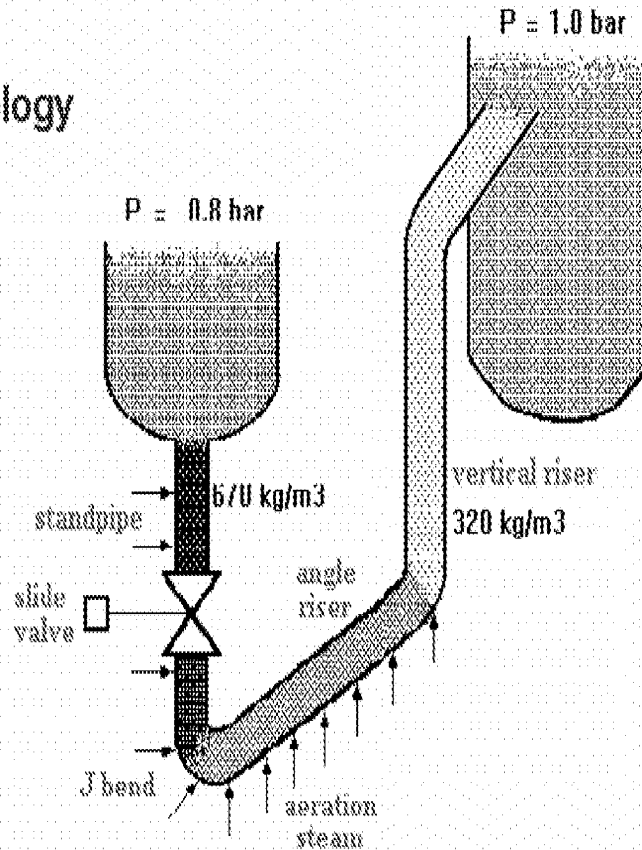
- ❖ under-aeration in standpipes results in too low pressure build-up
- ❖ too little aeration in risers results in slugging
- ❖ too much aeration in standpipes results in too low density and may cause bubbles
- ❖ too much aeration in risers causes excessive wear

- "Bubbles up" or "bubbles down"

- ❖ is determined by velocity differences between gas and particles
- ❖ is important for standpipe aeration

Transport in Fluidized State

- Transfer line terminology



- Pressure balance

- static pressure build-up in standpipe provides driving force for coke transport
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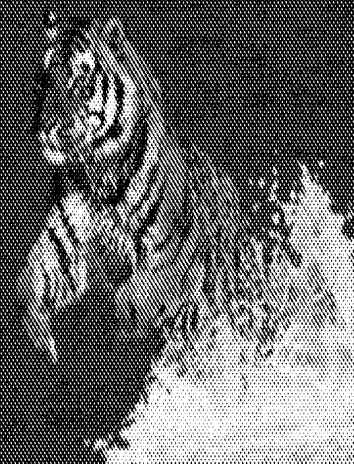
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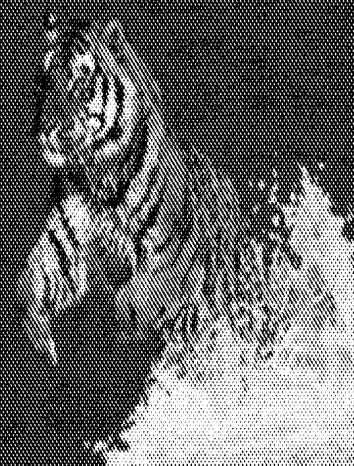
Successes and Disappointments over 17 years

- Significant (33%) capacity creep at low cost
- Runlength doubled; reliability is high priority
- 6 out of 7 runs completed as scheduled
- Air Blower problems 1 year after initial start-up
- Severe fouling in Heater Overhead Exchangers
- Gasifier Hot Spots
- Heater maintenance challenges



Reliability and thruput history

Run	Ton/hr	Days on oil
1	202	591
2	229	608
3	254	570
4	258	684
5	262	1048
6	265	1063
7	269	1195



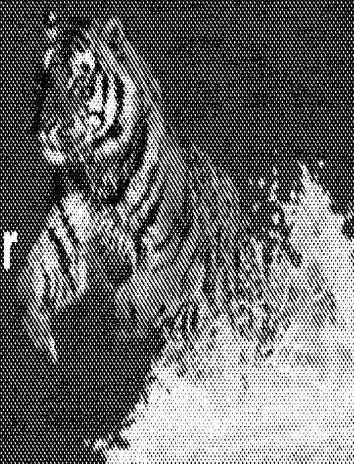
Reliability and thruput history

Reliability increases effective thruput !

- Good process follow-up and stable operation key to success
- DMC controller installed in 2001
- Some hardware changes essential too:
 - spare heat exchangers, material upgrading,
 - instrumentation upgrading, design changes
 - to reduce turnaround time
- Plan for current run is to increased from 3.5 to 4 years

1988-2003 debottlenecks

- minor Fluid Solids changes
- 2½ new distillation towers
- replaced a number of pumps
- diverted LPG from LPG/coker naphtha hydrofiner



Stretch run length with care :

Unplanned turnaround has high debits

	MEuro
• contractors ask more money for \pm same scope	1.5
• contractors need 14 days to mobilize result is additional downtime	4
• turnaround cost spread over shorter run	3.5
• coker down means Pipestill down jet and diesel to be purchased on spot market	3.5
• next run more conservative approach	2.5
• total additional cost of unplanned turnaround	15

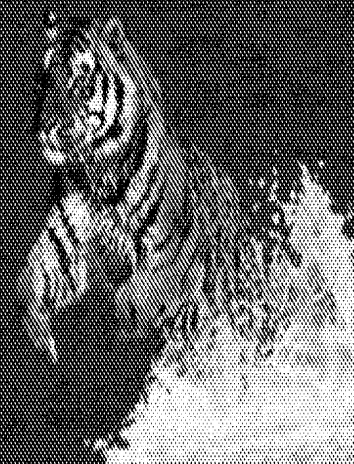
Partial reactor bog terminated run 2 prematurely



Air Blower problems 1 year after initial start-up

*High bearing temperature reading
made entire organization nervous*

- Serious problem or not ?
 - Repair required or do we reach turnaround ?
 - How to operate the coker and rest of the refinery ?
 - How to minimize risk and costs ?
-
- 2 day case study chemical + mechanical engineers



FLEXICOKING

- Questions ?

